



National Aeronautics and  
Space Administration



# Lighter-Than-Air (LTA) “AirStation” Unmanned Aircraft System (UAS) Carrier Concept

**Ron Hochstetler**

**SAIC**

**NASA Ames Research Center**

**[ronald.d.hochstetler@saic.com](mailto:ronald.d.hochstetler@saic.com)**

**Girish Chachad,**

**Matthew Blanken**

**SAIC**

**NASA Ames Research Center**

**[girish.h.chachad@nasa.gov](mailto:girish.h.chachad@nasa.gov)**

**[matthew.l.blanken@nasa.gov](mailto:matthew.l.blanken@nasa.gov)**

**John Bosma**

**ArcXeon LLC**

**[bachseakayaker@hotmail.com](mailto:bachseakayaker@hotmail.com)**



National Aeronautics and  
Space Administration



# Outline

- Introduction
- Background
- UAS Carrier Airship Concept of Operations (CONOPS)
  - Launch and Recovery
  - UAS Operations
  - Refueling
  - UAS Aircraft and Payloads
  - Airship Survivability
- Hypothetical UAS Carrier Mission
- UAS Carrier Airship Development Program
- Conclusions
- Q & A



National Aeronautics and  
Space Administration



# Introduction

- **Current Airship Operations**

- Provide surveillance over large geographic areas
- All sensors concentrated within the airship itself
- Airship must be in areas directly observed



**Long Endurance Multi-Intelligence  
Vehicle (LEMV)**

- **Future UAS Operations**

- DoD to deploy UAS from jets and turboprops (Gremlins & Arsenal Plane)
- Utilizing a carrier increases overall UAS endurance
- Allows for a distributed sensor net
- A flying carrier provides a mobile UAS base of operations with few geographical limits



**Depiction of DARPA Gremlins**



**Depiction of proposed Arsenal Plane**



# Introduction: UAS Carrier Airship Advantages

## UAS carrier airship operational capabilities

- Offer easily re-deployable and re-locatable mobile airborne UAS base
- Provide airspace access for long duration UAS operations
- Loiter at a safe location, but close enough to control, refuel, or replace UAS
- Provide local UAS resource for field commands, ships, or commercial package deliveries from above a city
- Provide self-contained transport of UAS ready for immediate operation
- Can recover other UAS launched from land or sea

# Flying Carrier Background

- 1930's airships were developed for deploying scout planes
- USS Macon and USS Akron
  - 25 ton payload
  - Manned scout biplanes
  - Sweep 165,000 sq. mi. in 12 hr.



**Left: USS Macon viewed  
from below.**

**Above: USS Macon above  
New York City in 1933.**



## Flying Carrier Background (cont.)

- **USS Akron and Macon built for long range strategic reconnaissance**
  - Operated 5 Sparrow Hawk planes up to 3 days
  - Planes stored in onboard hangar, launched and recovered by articulated trapeze



Sparrow Hawk engaging USS Macon trapeze



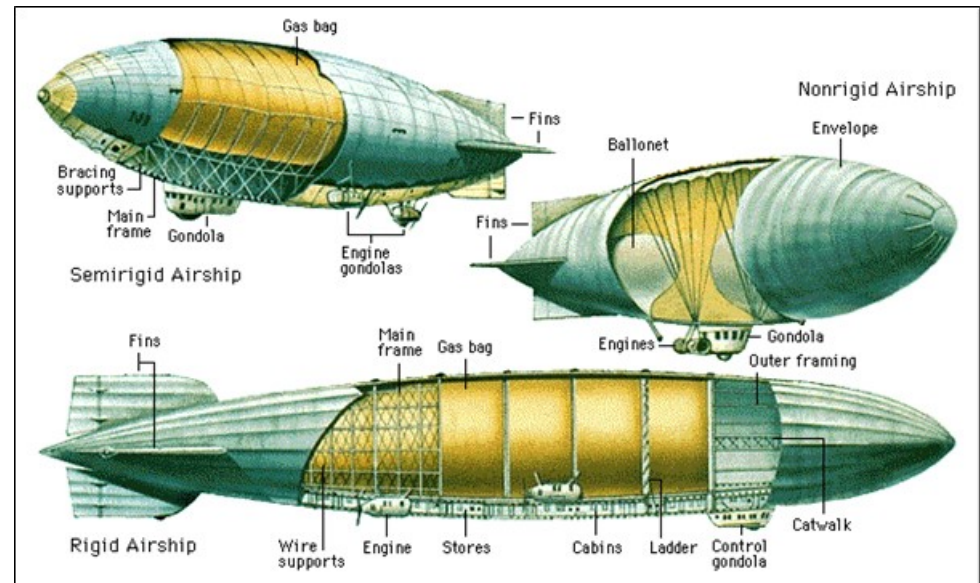
Plane hauled into USS Macon hangar



Model of airplane hangar and trapeze

# Modern Airship Types Background

- **Three types: non-rigid, semi-rigid, rigid**
  - Floats by displacing weight of air with LTA gas
- **Two airship classes:**
  - Near-buoyant and “hybrid”
- **Performance:**
  - Max speeds 85 to 95 kt., cruise speeds 40 to 50 kt.
  - Fuel consumption far less than jet with equal payload



Airship types



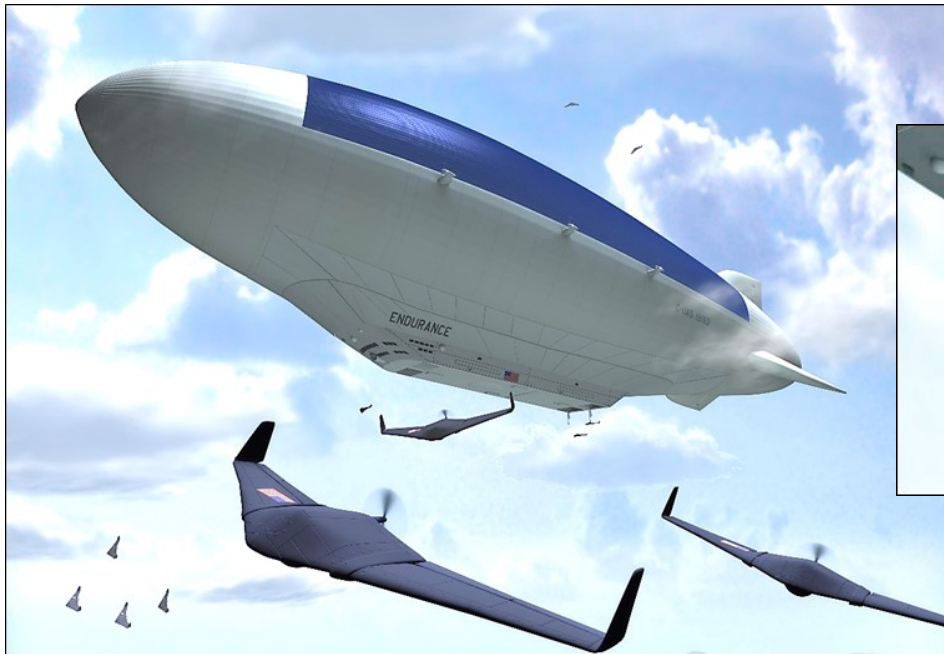
LMH-1 hybrid, non-rigid



Zeppelin N 07 near-buoyant, semi-rigid

# UAS Carrier Airship CONOPS

- **Launch and Recovery**
  - Robotic technologies can be used for UAS launch, recovery, and re-launch
  - Can accommodate simultaneous launch and recovery operations
  - Automated systems means small flight crew (2-4) (could be optionally piloted)
  - UAS can be operated by onboard pilots or remotely via data links to airship



Notional UAS Carrier airship with deployed UAS squadron



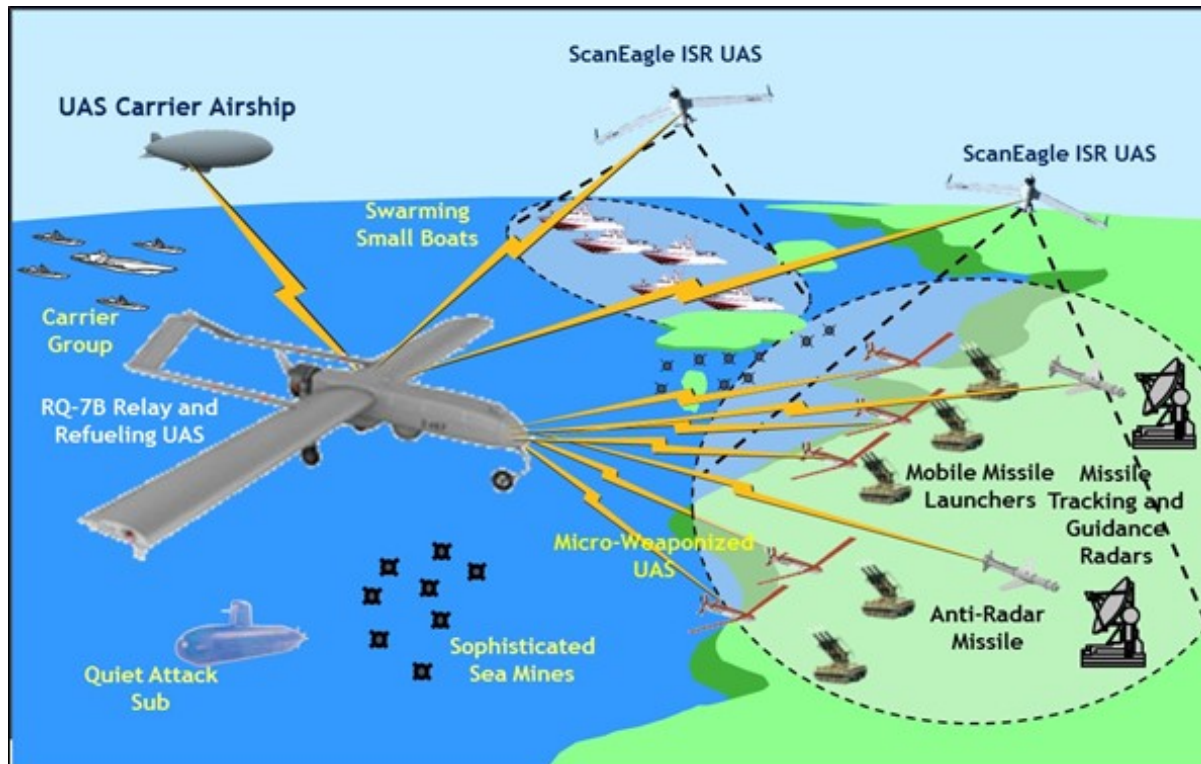
Concept for simultaneous  
launch and recovery of UAS



# UAS Carrier Airship CONOPS (cont.)

## Signal relay UAS operations

- UAS range extendable over-the-horizon (OTH) via signal relay UAS
- Airship hovers at remote location to reduce vulnerability and weather risks



OTH control of various UAS from airship via relay UAS



## UAS Carrier Airship CONOPS (cont.)

- **UAS Refueling**

- Modified trailing refueling drogue for UAS
- Robotic airship trapeze recovery and refueling
- Use signal relay aircraft for UAS-to-UAS refueling



Airship trails refueling  
drogue for UAS probe

- **Airship Refueling**

- Fuel bladder hoisted from ground or sea
- Optionally piloted “flying fuel tank”
  - Light plane modified to hook onto airship in flight
  - Airplane pumps fuel to airship from onboard tank



UAS-to-UAS in-flight refueling



“Pelican” optionally piloted Cessna 337, O2, Skymaster

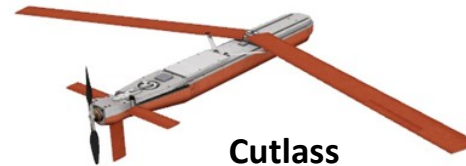


Air-liftable fuel transport bladders

# UAS Carrier Airship CONOPS (cont.)

- **Military UAS**

- L3 Cutlass
- Boeing Dominator
- Boeing RQ-21a Blackjack
- Textron Systems RQ-7b Shadow



Cutlass



Dominator



Blackjack



Shadow

- **Payloads:**

- Cameras, miniature synthetic aperture radars (SAR), imaging laser radars (LADARs)

- **Civilian/Commercial UAS**

- Quad/Hex/Octo –copters
- Fixed wing / vectored lift

- **Payloads:**

- Emergency response supplies
- Commercial packages



Hex-rotor  
package delivery



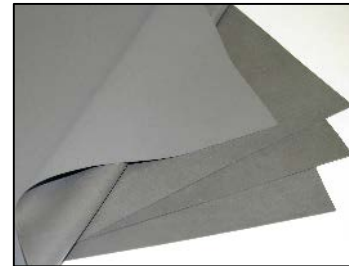
Fixed wing package  
delivery UAS



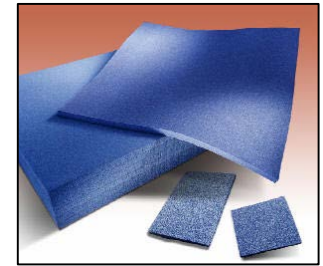
# UAS Carrier Airship CONOPS (cont.)

## Airship Survivability

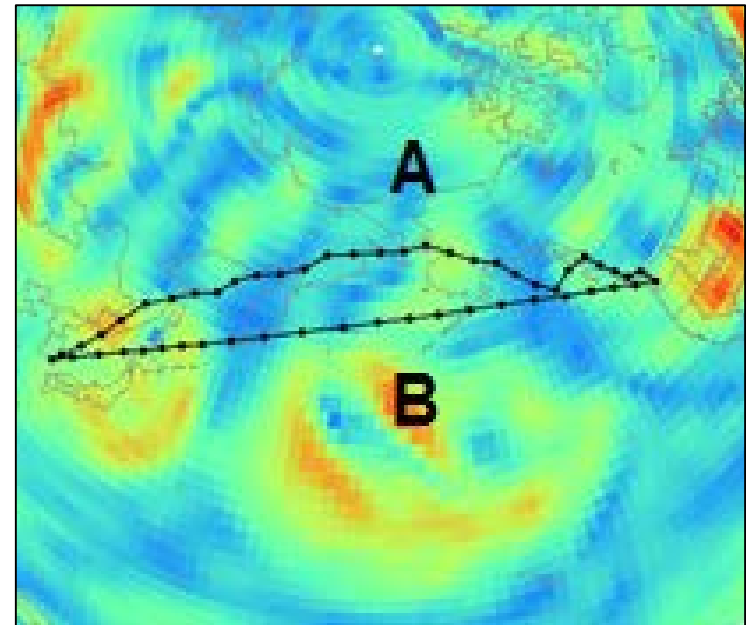
- Invulnerable to sea mines and torpedoes
- Fabric structures are tolerant of small hole damage (low leakage)
- Airship hull, structures, and engines can be treated for visual, RF, and EO/IR stealth characteristics
- Other systems can provide electronic and kinetic self-defense
- Weather-optimized flight route planning enables airship to avoiding damaging weather



RF absorbent fabrics



Radar absorbent foam



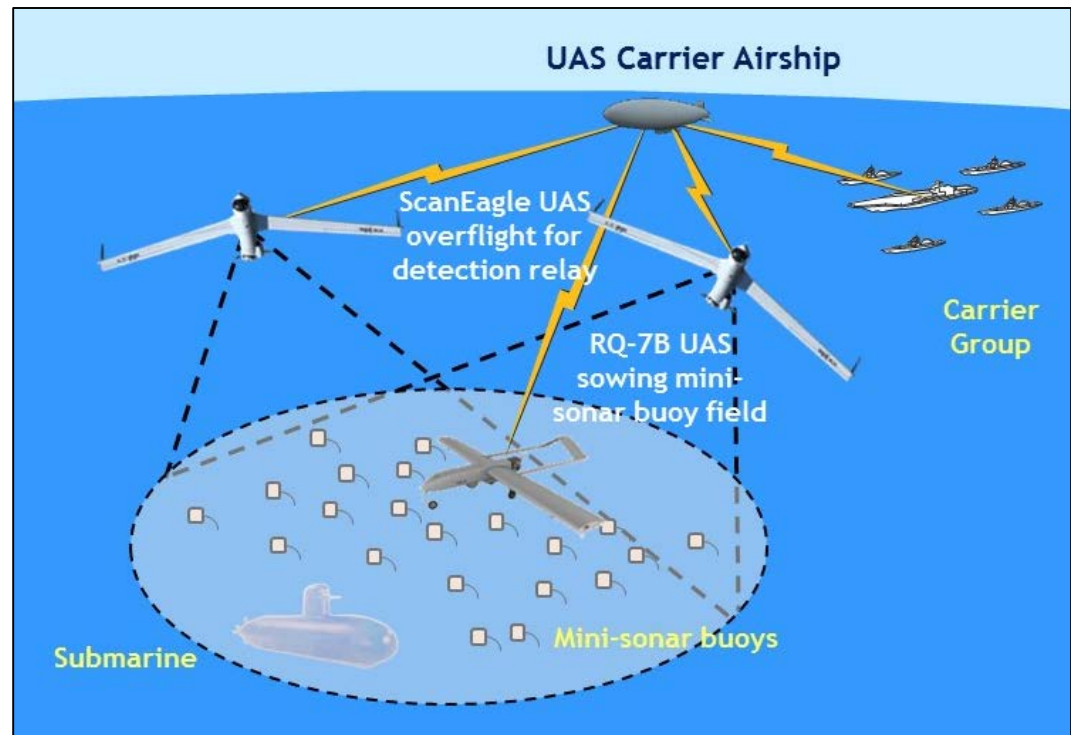
Weather optimized airship route (A) vs Great Circle route (B) between Ft. Lewis and Pusan



# Hypothetical UAS Carrier Mission

- **Anti-Submarine Warfare (ASW)**

- UAS carrier airship positioned at safe stand-off range of 50 – 100 nm, from sub search area at 10,000 to 15,000 ft. MSL
- RQ-7B UAS aircraft “sow” mini-sonar buoys in sea
- ScanEagle UAS maintain overflight relaying detection signals from sonar buoys
- UAS carrier sends UAS to maintain continuously refreshed sonar buoy field and replacement of overflight UAS



# UAS Carrier Development Program

- Technology exists to develop medium (10 ton) to large (45 ton) UAS carrier airships
- Staged development would enable investigation and design of all concept components
- Extensive modeling and simulation is needed to investigate and refine airship vehicle, UAS support systems, and operational concepts
- Available manned and unmanned airships can provide sub-scale development of all essential systems and flight test validations



**Concept of UAS airship with two ScanEagles attached to recovery platforms**



## Conclusions

- **UAS carrier airship is the next logical step in the deployment of UAS for military and civilian applications**
  - Provides an operationally flexible airborne UAS operations base
  - Provides UAS range extension via OTH relay UAS and inflight UAS refueling
  - Offers potential as a cost effective means to operate large groups of UAS in coordinated tasks
  - Current technologies are in hand to develop the UAS carrier airship and its UAS support systems



National Aeronautics and  
Space Administration



# Questions?